EE 100/42 Spring 2009
Solutions to Homework 8

7.1 **1.** Provided that the noise amplitude is not too large, the logic values represented by a digital signal can still be determined after noise is added.
2. Component values in digital circuits do not need to be as precise as in analog circuits.
3. Very complex digital logic circuits (containing millions of components) can be economically produced. Analog circuits often call for large capacitances and/or precise component values that are impossible to manufacture as large scale integrated circuits.

7.6 (a) 5.625 (b) 7.75 (c) 10.25 (d) 7.875 (e) 8.3125 (f) 21.375

7.9 (a) 10011.101 (b) 10000 (c) 10111.000

7.15 (a) 778 (b) 1000 (c) 778

7.23 If the variables in a logic expression are replaced by their inverses, the AND operation is replaced by OR, the OR operations is replaces by AND, and the entire expression is inverted, the resulting logic expression yields the same values as before the changes. In equation form, we have:

$$ABC = \overline{\overline{A} + \overline{B} + \overline{C}} \qquad (A + B + C) = \overline{\bar{A}\bar{B}\bar{C}}$$

7.26 (a) Truth table for $D = ABC + A\overline{B}$

A	B	C	**D**
0	0	0	**0**
0	0	1	**0**
0	1	0	**0**
0	1	1	**0**
1	0	0	**1**
1	0	1	**1**
1	1	0	**0**
1	1	1	**1**

(b) Truth table for $E = AB + A\overline{B}C + \overline{C}D$

A	B	C	D	**E**
0	0	0	0	**0**
0	0	0	1	**1**
0	0	1	0	**0**
0	0	1	1	**0**
0	1	0	0	**0**
0	1	0	1	**1**
0	1	1	0	**0**
0	1	1	1	**0**
1	0	0	0	**0**
1	0	0	1	**1**
1	0	1	0	**1**
1	0	1	1	**1**
1	1	0	0	**1**
1	1	0	1	**1**
1	1	1	0	**1**
1	1	1	1	**1**

(c) Truth table for $Z = WX + (\overline{W + Y})$

W	X	Y	**Z**
0	0	0	**1**
0	0	1	**0**
0	1	0	**0**
0	1	1	**0**
1	0	0	**1**
1	0	1	**1**
1	1	0	**0**
1	1	1	**1**

(d) Truth table for $D = A + \overline{A}B + C$

A	B	C	**D**
0	0	0	**0**
0	0	1	**1**
0	1	0	**1**
0	1	1	**1**
1	0	0	**1**
1	0	1	**1**
1	1	0	**1**
1	1	1	**1**

(e) Truth table for $D = (\overline{A + BC})$

A	B	C	**D**
0	0	0	**1**
0	0	1	**1**
0	1	0	**1**
0	1	1	**0**
1	0	0	**0**
1	0	1	**0**
1	1	0	**0**
1	1	1	**0**

7.27 (a) $F = (A + B)\overline{C}$
(b) $F = A + B + (\overline{BC})$
(c) $F = AB + (\overline{BC}) + D$

7.40

$$\begin{aligned} F &= \bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + A\bar{B}C + ABC \\ &= \sum m(0,2,5,7) \end{aligned}$$

$$\begin{aligned} F &= (A + B + \overline{C})(A + \overline{B} + \overline{C})(\overline{A} + B + C)(\overline{A} + \overline{B} + C) \\ &= \prod M(1,3,4,6) \end{aligned}$$

7.41

$$\begin{aligned} G &= \bar{A}\bar{B}\bar{C} + \overline{A}BC \\ &= \sum m(0,3) \end{aligned}$$

$$\begin{aligned} G &= (A + B + \overline{C})(A + \overline{B} + C)(\overline{A} + B + C)(\overline{A} + \overline{B} + C)(\overline{A} + \overline{B} + \overline{C}) \\ &= \prod M(1,2,4,5,6,7) \end{aligned}$$

7.42

$$\begin{aligned} H &= \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + A\bar{B}C + AB\bar{C} + ABC \\ &= \sum m(0,1,2,4,5,6,7) \\ H &= (A + \overline{B} + \overline{C}) = M(3) \end{aligned}$$

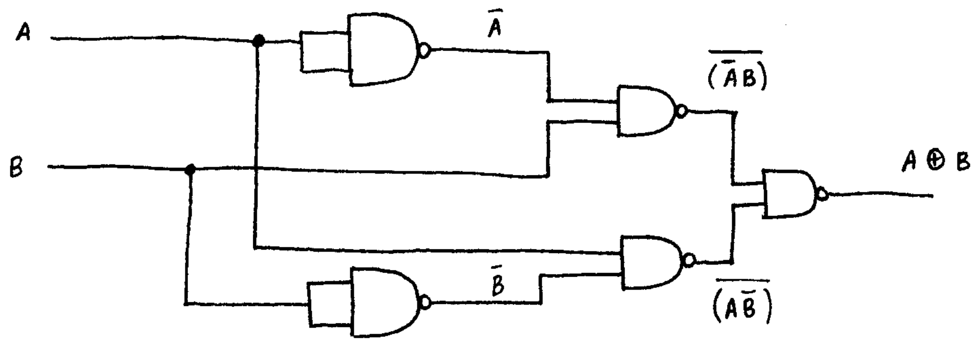
7.49 Truth Table:

A	B	**A ⊕ B**
0	0	**0**
0	1	**1**
1	0	**1**
1	1	**0**

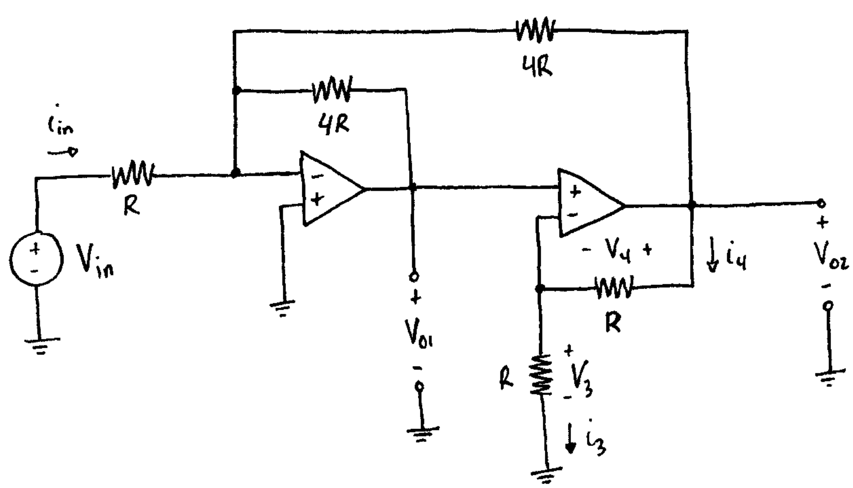
Thus we can write the product of the sums expression and apply DeMorgan's Laws to obtain:

$$A \oplus B = (A\overline{B})(\overline{A}B) = \overline{\overline{(A\overline{B})} * \overline{(\overline{A}B)}}$$

The circuit is:



14.34 Circuit Diagram:



From the circuit we can write:

$$\begin{aligned} V_{o1} &= V_3 \\ i_4 &= i_3 = \frac{V_{o1}}{R} \end{aligned}$$

Thus we have:

$$
\begin{aligned}
V_4 &= V_3 = V_o1 \\
V_{o2} &= V_3 + V_4 = 2V_{o1} \\
i_{in} &= -\frac{V_{o1}}{4R} - \frac{V_{o2}}{4R} \\
i_{in} &= \frac{V_{in}}{R} \\
\frac{V_{in}}{R} &= -\frac{V_{o1}}{4R} - \frac{V_{o2}}{4R} \\
A_1 &= \frac{V_{o1}}{V_{in}} = -\frac{4}{3} \\
A_2 &= \frac{V_{o2}}{V_{in}} = \frac{2V_{o1}}{V_{in}} = 2A_1 = -\frac{8}{3}
\end{aligned}
$$